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MANAGEMENT OF LEAF BLIGHT OF CHRYSANTHEMUM WITH STORED COMPOST TEAS

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ABSTRACT

Among the non chemical means like bio control methods, use of compost teas as prophylactic protectants for disease management is becoming an important area of research. However to avoid the laborious process it is good to store the compost teas for later use. So, effect of storage period on pH, EC, micronutrient status, microbial population and disease suppressiveness was studied. All these parameters recorded changes among fresh, 60 days and 120 days stored compost teas. The variation of PDI in fresh compost teas is from 4.67% (CT6) to 38.34% (Control). Where as for 120 day old teas, it varied from 15 (CT6) to 45 (Control). The efficacy of compost teas upon storage is depended upon its source ingradients, method of compost, period of storage, however can be stored for 3-6months period for suppression of foliar diseases.

Keywords : *Compost teas, storability, disease; management.*

Plant diseases are being effectively managed with several systemic, non systemic fungicides, antibiotics and other diverse chemicals. Continuous use of fungicides has adverse effects like residues on produce, toxicity to the human beings and animals, soil and water pollution, non target effects like disturbing the natural enemies, development of resistant strains. Non chemical methods are beneficial to manage the diseases, which can be long lasting and cheaper than chemical methods.

Among the non chemical means like bio control methods, use of compost teas as prophylactic protectants for disease management is becoming an important area of research. Over the last two decades, there have been reports of the use of compost water extracts for control of foliar diseases. Extracts are prepared by mixing compost and water and incubating the resulting slurry with or with out agitation for several days is otherwise known as compost teas. The key factors influencing the effectiveness of the compost tea were the age of the compost and nature of its source ingredients and components (1). The addition of compost teas to growing media encourage the growth of benign organisms, which suppress the plant diseases (2). Similarly, they can be sprayed on crop to coat leaf surfaces, and so that they provide resistance to infection from pathogens (3). Compost teas show multiple modes of activity in suppressing plant diseases like, suppression of spore germination, induced resistance, antibiosis and competition. Regardless of the mode of action, preventive application before pathogen infection appears is necessary for optimal control through all known mode of actions (4).

All these reports confirming that compost teas can effectively control the plant diseases, and can replace the fungicide and chemical control methods to some extent. However to avoid the laborious process it is good to store the compost teas for later use. But so far no research has been done on this line. So an experiment was conducted to study the storability of the compost teas in the disease management.

MATERIALS AND METHODS

Preparation of composts

The composts prepared from Vermicompost (CT1), Vermicompost + *Pseudomonas fluorescens* 1% (CT2), Vermicompost + *Trichoderma viride* 1% (CT3), Dung 75% + Paddy Straw 25% (CT4), Dung75% + Paddy Straw 25% + *Pseudomonas fluorescens* 1% (CT5), Dung 75% + Paddy Straw 25% + *Trichoderma viride* 1% (CT6), Dung 75% + Neem Powder 20% + Fish meal 5% (CT7), Dung75% + Neem Powder 20% + Fish meal 5% + *Pseudomonas fluorescens* 1% (CT8) and Dung 75% + Neem Powder 20% + Fish meal 5% + *Trichoderma* *viride* 1% (CT-9). The ingredients were thoroughly mixed and filled in plastic containers and wetted by sprinkling enough water to trigger the decomposition process. These containers were tightly covered with black polythene sheet and were allowed for 60 days for decomposition. These composts were remixed manually at 30 days for proper mixing and sprinkled with water to maintain moisture for better decomposition, and left for 30 days to get the ripe compost.

Preparation of compost teas

Compost teas were extracted (5) from above composts and the teas were placed in screw capped bottles and stored in an incubator at 26+2°C. The teas were tested for the changes in pH, electrical conductivity, micronutrients like copper, manganese, iron and zinc at 0, 60, 120 days after extraction and storage. The microbial load and disease suppressiveness of the teas was also tested at 0 and 120 days after storage.

Estimation of pH, electrical conductivity, micro-nutrients

For the estimation of pH, electrical conductivity (EC) and micronutrients in compost teas, 100 ml of sample was taken out from stored compost teas. The pH was measured using pH meter ELICO L1610 model. Similarly, the EC was measured with EC meter ELICO CM 180 model. The micronutrients copper, manganese, iron and zinc content of the extracts was estimated by using atomic absorption spectro-photometer model varian FS 240.

Microbial population of compost teas

One ml of compost tea stored in screw capped bottles was taken with pipette, serial diluted and transferred into petriplates. Later 15 ml of nutrient agar medium was transferred into each plate and incubated at 26 ± 2°C. The number of colony forming units were counted using coulter colony counter and the microbial population was described as cfu/ml.

Disease suppression ability

Disease suppression ability of stored compost teas was tested in in vitro by the Detached Leaf Technique (6) against leaf blight of chrysanthemum. In this, experiment, ten healthy leaves of each cultivar were collected and were dipped in the spore suspension of Alternaria alternata 50 x 103 spores/ml. The leaves dipped in the spore suspension were placed in the petriplate lined with moist blotting paper and sprayed with compost teas, incubated at 26+20 C and observed for appearance of symptoms. The Percent Disease Index was calculated following 0-5 scale given by Mayee and Datar (7).

RESULTS AND DISCUSSION

Effect of storage of compost teas on pH, electrical conductivity and micro nutrients

Effect of storage on the pH, electrical conductivity (EC) and micronutrients was studied. Changes in pH of compost teas at different storage periods were shown in table-1. The pH values of fresh compost teas varied from 8.1 (CT3) 8.9 to (CT6). While in 60 day old teas it varied from 8.07 (CT4) to 8.66 (CT8) and in 120 day old teas it ranged from 6.87 (CT1) to 8.29 (CT7). Among compost teas, the pH of CT4, CT5, CT7, CT8 and CT9 was gradually decreased from fresh to 120 day old compost tea. In CT2 and CT6, there was no significant difference in pH of fresh and 60 day old compost teas but decreased by the end of 120 days. pH of CT1 and CT3 increased after storing for 60 days but decreased after storage for a period 120 days.

The data pertaining to the effect of storage period of compost teas on their EC is presented in table-1. The EC values of fresh compost teas ranged from 8.52 ds/m^2 (CT7) to 17.01 ds/m^2 (CT5). For 60 day old teas the values varied from 8.52 ds/m^2 (CT7) to 17.01 ds/m^2 (CT5) similarly for 120 day old teas varied from 5.68 ds/m^2 (CT9) to 9.73 ds/m^2 (CT3). In case of EC, there was no significant difference in fresh and 60 day old teas but the EC decreased after 120 days of storage.

The data pertaining to micronutrients copper and manganese in compost teas is presented in table-2. The amount of copper in fresh compost teas varied from 0.09 ppm (CT5) to 0.33 ppm (CT9). For 60 day old teas the values varied from 0.13 ppm (CT3) to 0.79 ppm (CT8). Similarly for 120 day old teas it ranged from 0.2 ppm (CT4) to 0.6 ppm (CT8). The amount of copper increased on storage from fresh to 120 day old compost teas.

Table-1: Effect of storage period on the pH and electrical conductivity of compost teas.

S.No	Treatment	PH				Electrical conductivity in ds/m^2			
		Storage period				Storage period			
		0 days	60 days	120 days	Mean	0 days	60 days	120 days	Mean
1	CT-1	8.20	8.71	6.87	7.93	10.45	10.45	8.61	9.88
2	CT-2	8.80	8.73	8.06	8.53	10.08	10.78	9.65	10.17
3	CT-3	8.10	8.79	7.51	8.12	11.48	11.51	9.73	10.91
4	CT-4	8.40	8.07	7.67	8.05	16.27	16.27	6.57	9.38
5	CT-5	8.80	8.71	8.03	8.51	17.01	17.01	8.95	14.13
6	CT-6	8.90	8.82	7.95	8.56	11.57	11.57	6.55	9.81
7	CT-7	8.68	8.14	8.29	8.37	8.52	8.52	6.33	7.65
8	CT-8	8.76	8.66	8.01	8.48	12.51	12.15	6.12	10.40
9	CT-9	8.76	8.41	7.79	8.32	10.3	10.30	5.68	8.80
	Mean	8.6	8.56	7.8		12.02	12.06	7.58	

	pH		EC ds/m^2	
Factors	C.D.(0.05)	SE m+	C.D.(0.05)	SE m+
Compost teas	0.08	0.027	0.49	0.17
Storage period	0.13	0.046	0.85	0.3
Interaction	0.23	0.08	1.47	0.52

The effect of storage period of compost teas on manganese content is detailed in table 2. The amount of manganese of fresh compost teas ranged from 0.05ppm (CT2) to 1.1 ppm (CT8). For 60 day old teas the values varied from 0.14 ppm (CT1) to 1.6 ppm (CT8). Where as after storing for 120 day old teas the amount of manganese ranged from 1.68 ppm (CT1, CT4) to 15.97 ppm (CT8). Amount of manganese increased gradually except in CT1 in all compost teas from the teas stored from 0 days to 120 days.

Table-2 : Effect of storage period on content of copper and manganese in compost teas.

S.No	Compost tea	Amount of Copper in ppm				Amount of Manganese in ppm			
		Storage period				Storage period			
		0 days	60 days	120 days	Mean	0 days	60 days	120 days	Mean
1	CT-1	0.14	0.18	0.24	0.19	0.17	0.14	1.68	0.66
2	CT-2	0.15	0.34	0.36	0.28	0.05	0.18	1.96	0.73
3	CT-3	0.17	0.13	0.32	0.21	0.11	0.23	2.52	0.95
4	CT-4	0.16	0.16	0.20	0.17	0.08	0.19	1.68	0.65
5	CT-5	0.09	0.20	0.36	0.22	0.06	0.36	5.32	1.91
6	CT-6	0.15	0.32	0.24	0.24	0.09	0.21	2.52	0.94
7	CT-7	0.20	0.31	0.40	0.30	0.67	0.91	11.20	4.26
8	CT-8	0.20	0.79	0.60	0.53	1.10	1.60	15.97	6.22
9	CT-9	0.33	0.42	0.40	0.38	0.74	3.07	14.56	6.12
	Mean	0.18	0.32	0.35		0.34	0.77	6.38	

	Copper content		Manganese content	
Factors	C.D. (0.05)	Sem ±	C.D. (0.05)	Sem ±
Compost teas	0.01	0.005	0.4	0.14
Storage period	0.03	0.009	0.69	0.24
Interaction	0.04	0.015	1.2	0.42

Table-3 : Effect of storage period on Iron and zinc content in compost teas.

S.No	Compost tea	Amount of Iron in ppm				Amount of Zinc in ppm			
		Storage period				Storage period			
		0 days	60 days	120 days	Mean	0 days	60 days	120 days	Mean
1	CT-1	0.19	0.34	0.76	0.43	0.12	0.10	0.00	
2	CT-2	0.21	0.56	0.68	0.48	0.11	0.18	0.00	0.07
3	CT-3	0.34	0.06	0.84	0.42	0.15	0.30	0.08	0.1
4	CT-4	0.41	0.40	1.16	0.66	0.18	0.16	0.08	0.18
5	CT-5	0.17	3.77	2.68	2.21	0.19	0.24	0.16	0.14
6	CT-6	0.50	1.85	1.40	1.25	0.17	0.23	0.04	0.2
7	CT-7	5.96	5.96	7.68	6.53	0.51	0.58	0.68	0.15
8	CT-8	19.18	16.20	18.96	18.11	0.87	0.69	1.04	0.59
9	CT-9	11.31	6.94	11.36	9.87	0.58	0.45	0.76	0.87
	Mean	4.25	4.01	5.06		0.32	0.33	0.32	0.6

	Copper content		Manganese content	
Factors	C.D. (0.05)	Sem ±	C.D. (0.05)	Sem ±
Compost teas	0.03	0.11	N.S.	0.02
Storage period	0.53	0.18	0.11	0.039
Interaction	0.91	0.32	0.19	0.067

The variations in iron content of compost teas due to different storage periods were presented in table-3. The amount of iron in fresh compost teas ranged from 0.19ppm (CT1) to 19.18 ppm (CT8). For 60 day old teas the values varied from 0.06 ppm (CT3) to 16.2 ppm (CT8). Amount of iron content in 120 day old teas ranged from 0.68 ppm (CT2) to 18.96 ppm (CT8). In CT3, CT4, CT8 and CT9 amount of iron decreased in 60 day old tea from fresh then increased in 120 day old. It is increased in 60 day old and then decreased in 120 day old compost teas of CT6 and CT5. However the amount of iron is increased after 120 days storage compared to fresh compost teas.

The observations on the micronutrient zinc variation were recorded in table-3. The amount of zinc in fresh compost teas varied from 0.11 ppm (CT2) to 0.87 ppm (CT8). In the 60 day old teas the values varied from 0.1 ppm (CT1) to 0.69 ppm (CT8). Where as in 120 day old teas it ranged from 'traces' ppm (CT2, CT1) to 1.04 ppm (CT8). The amount of zinc increased in 60 day old and then decreased in 120 day old CT3, CT2, CT6 and CT5. On the other hand, the amount of zinc decreased in 60 day old and then increased in 120 day old CT9 and CT8. Gradual decrease observed in CT1 and CT4 and a gradual increase is observed in CT7. Drastic decrease in 120 day old observed in CT1, CT2 and CT6. At the end of 120 days storage the amount of zinc is decreased in CT1 to CT6. It increased in CT7, CT8 and CT9.

Table-4 : Effect of storage period of compost teas on microbial population.

S.No	Treatment	Microbial Population (–X 10^6 *cfu /ml)		Mean
		Storage period		
		3 Month	7 Month	
1	CT-1	527.30	1192.00	859.65
2	CT-2	257.49	291.50	274.5
3	CT-3	126.41	67.00	96.71
4	CT-4	222.41	190.04	206.23
5	CT-5	830.47	727.2	778.83
6	CT-6	300.26	133.26	116.76
7	CT-7	100.45	176.06	138.26
8	CT-8	101.18	141.09	121.14
9	CT-9	315.45	116.53	215.99
	Mean	309.05	337.19	

Factors	C.D.(0.05)	Sem+
Compostteas	5.96	2.08
Storageperiod	12.65	4.41

Colony forming units

Significant reduction in the microbial population was observed in compost teas stored for 120 days than fresh compost teas (Table 4). In each compost tea there is significant reduction in population except for CT4 and CT8, which are on par with respective fresh teas.

Disease suppression ability

The disease suppression ability of compost teas reduced significantly on storage. Results presented in table 5 revealed that there was a significant reduction in disease control. But all the teas were significantly superior over control that recorded 45 percent disease index in suppressing the disease. The variation of PDI in fresh compost teas is from 4.67% (CT6) to 38.34% (Control). Where as for 120 day old teas, it varied from 15 (CT6) to 45 (Control).

Storage of compost teas after extraction will influence the chemical properties like pH, electrical conductivity, micronutrients and biological properties like colony forming units, percent disease index. In the present investigation, compost teas were stored and analyzed after 0, 60 and 120 days of storage.

The pH of compost teas was reduced gradually from fresh to 120 days after storage in CT4, CT5, CT7, CT8 and CT9 (Table-1). In CT2 and CT6, there was no significant difference in pH of fresh and 60 days old compost teas but it decreased by the end of 120 days of storage. Where as CT1 and CT3 the pH increased after storing for 60 days old but decreased after 120 days.

Electrical conductivity (EC) is a measure of total soluble salts expressed as ds/cm or millimhos/cm. In case of EC, the differences between fresh and 60 days were non significant but the same after 120 days of storage (Table-1).

The amount of copper increased gradually from fresh to 120 days old compost teas of CT1, CT2, CT5 and CT7 (Table-2). It is increased in CT6, CT9 and CT8 from fresh to 60 days old and then decreased to 120 days old teas. This indicating that the peak copper content is present in 60 day old teas and least was in fresh compost teas. In case of CT3 the amount of copper is first decreased and then increased significantly. There is no significant difference in amount of copper in CT4 between fresh, 60 day and 120 day old teas. Amount of manganese increased gradually except in CT1 (Table-2). In all compost teas, an increase in manganese content was observed in 120 day old teas than their respective 60 day old teas, especially in CT7, CT8 and CT9. In CT3, CT4, CT8 and CT9 the amount of iron decreased in 60 days old tea in comparison with fresh and then it increased in 120 days old compost teas (Table-3). The amount of zinc increased in 60 day old and then decreased in 120 day old compost teas in CT3, CT2, CT6 and CT5 (Table-3). On the other hand, the amount of zinc decreased in 60 day old and then increased in 120 day old compost tea in CT9 and CT8.

Storage of composts teas from 0 to 120 days has resulted in decrease in the number of colony forming units except in CT4 and CT8 (Table-4). The decreased number of colony forming units in compost teas may be due to the decline in nutrients or due to the accumulation of metabolites at toxic levels.

There is no information on the changes in the pH, EC, micronutrients and microbial population upon storage of compost teas. However some authors studied the properties of fresh compost teas and observed the variations among the compost tea to compost tea depending on the substrate used. Aerobic compost teas fermented with fungal additives had pH of 8.5 (8) studied the chemical and biological properties of compost water extracts and reported that the extracts prepared from chicken manure and cattle manure recorded pH of 7.33 and 7.57 and an electrical conductivity of 2.47dS/cm and 0.51dS/cm respectively and these factors effects the quality and storability of compost teas. All aerobic compost teas produced with the molasses based additive, there was a threshold of bacterial population density (6 log 10 active cells per ml, 7.48 log10 total cells per ml or 7log10 cfu/ml) above which compost teas were suppressive (8).

Storage of compost teas for a period of 120 days has reduced the disease suppressiveness in all compost teas over the fresh ones. However all the compost teas were significantly superior over control even after storing for 120 days (Table-5).

The present results are in agreement with those of

Table-5 : Effect of storage period of compost teas on PDI of Chrysanthemum leaf blight caused by Alternaria alternata

S.No	Treatment	Percent Disease Index		Mean
		Storage period		
		0 days	120 days	
1	Control	38.34 (38.23) *	45.00 (42.10)	41.64(40.17)
2	CT-1	8.00 (16.40)	26.67 (30.93)	17.34(23.67)
3	CT-2	7.14 (15.47)	26.67 (30.93)	16.91(23.2)
4	CT-3	8.64 (17.02)	25.00 (29.91)	16.82(23.46)
5	CT-4	10.34 (18.74)	25.00 (29.91)	17.67(24.33)
6	CT-5	7.74 (16.13)	25.00 (29.91)	16.37(23.02)
7	CT-6	4.67 (12.43)	15.00 (22.59)	9.84(17.51)
8	CT-7	8.48 (16.91) *	30.0 (33.14)	19.24 (25.03)
9	CT-8	8.00 (16.40)	25 (29.91)	16.5(23.16)
10	CT-9	9.30 (17.73)	30.00 (33.15)	19.65(25.44)
	Mean	11.35 (18.73)	27.0 (31.25)	

Factors	C.D. (0.05)	SEm ±
Compost teas	1.46	0.51
Storage period	3.26	1.14
Interaction	4.61	2.28

(10) who reported that anaerobically fermented extract of spent mushroom substrate maintained disease suppressing efficacy after storage at -200C, 40C and at room temperature for at least 4 months. According to (11) the storability of compost teas also depends upon the source ingredients in compost. And compost teas made from spent mushroom substrate started losing the inhibitory nature after 13 weeks. On the other hand, (12) confirmed that compost teas made from municipal waste compost lost their inhibitory nature upon storage because of production of acetic acid while in storage.

From the present study it was concluded that, the efficacy of compost teas upon storage is depended upon its source ingradients, method of compost, period of storage etc., however can be stored for 3-6 months period for suppression of foliar diseases like caused by Alternaria alternata.

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